

PATENT CLAIMS

1. A ceramic composite material containing a ceramic substrate material, characterized in that at least one biological material, and at least one nanoparticulate reinforcing material are homogenously embedded in the substrate material.
2. The composite material according to claim 1, wherein the reinforcing material comprises nanoparticulate oxides of elements of the II to V main or subgroup of the periodic table, or the mixtures thereof.
3. The composite material according to claim 2, wherein the reinforcing material comprises nanoparticulate hydrolysis products of trialkoxy silanes, or the mixtures thereof.
4. The composite material according to one of the preceding claims, wherein the proportion of the reinforcing material is up to 70 percent by weight.
5. The composite material according to one of the preceding claims, wherein the reinforcing material comprises nanoparticles with a mean particle diameter smaller than 200 nm.
6. The composite material according to one of the preceding claims, wherein the biological material comprises biological cells, cell groups, cell components, or biologically effective macromolecules.
7. The composite material according to claim 6, wherein the biological material comprises living or viable organisms.

8. The composite material according to claim 7, wherein the biological material comprises bacteria, fungi, spores of bacteria or fungi, protozoans, algae, animal cells, vegetable cells, animal cell groups, or vegetable cell groups.
9. The composite material according to claims 7 or 8, wherein the proportion of the living organisms is 0.1 to 30 wt.-% based on the dry composite material.
10. The composite material according to one of the preceding claims, wherein the ceramic substrate material comprises aluminum oxide or aluminosilicate.
11. The composite material according to one of the preceding claims, wherein at least one additive for increasing the biological activity, and/or at least one water soluble polymer is embedded in the substrate material.
12. The composite material according to claim 11, wherein the additive for increasing the biological activity comprises polyols, glycerol, and/or nutrients.
13. The composite material according to claim 11, wherein the at least one water soluble polymer comprises polyvinyl alcohol or polyacrylic acid.
14. The composite material according to one of the claims 11 to 13, wherein the proportion of the embedded additives is up to 30 wt.-% based on the dry composite material.
15. A method for the production of a ceramic composite material according to one of the preceding claims with the following steps:

- producing a slurry made up of an aqueous dispersion of the substrate material and a dispersion of the dispersed biological material,
  - adding the nanoparticulate reinforcing material,
  - reinforcing the material by means of neutralization of the slurry with the reinforcing material at room temperature, or by means of a freezing process so that the composite material is formed, and
  - final drying of the composite material.
16. The method according to claim 15, wherein aluminum oxide or aluminosilicate powder or fibers are added to the slurry as the substrate material.
17. The method according to claim 15 or 16, wherein additional additives are added to the slurry for improving the biological activity and increasing the mechanical stability.
18. The method according to one of the claims 15 to 17, wherein the reinforcing is carried out in a mold.
19. The method according to one of the claims 15 to 18, wherein the freezing process comprises a freeze-treatment of the composite material at a temperature of up to -80 °C.
20. The method according to claim 19, wherein the freeze-drying of the composite material occurs at a temperature below the freezing point of water at up to -10 °C.
21. Use of a composite material according to one of the claims 1 to 14 as a biocatalyst or biofilter for the treatment of fluids.

22. Use of a composite material according to one of the claims 1 to 14 for the production of ceramic materials.